HANDOUT 10:
PCF: Environments and Materials

Environments and Materials

Young children actively construct mathematical knowledge through everyday interactions with their environment. Setting up a high-quality physical environment is essential for children's mathematical development. The preschool environment sets the stage for children's physical and social exploration and construction of mathematical concepts. It should provide access to objects and materials that encourage children to experiment and learn about key mathematical concepts through everyday play.

- **Enrich the environment with objects and materials that promote mathematical growth.**
  Provide children with access to developmentally appropriate, challenging, and engaging materials. A high-quality environment offers children opportunities to count objects; to explore and compare objects' size, shape, weight, and other attributes; to measure; to sort and classify; and to discover and create patterns. For example, wooden blocks, geometric foam blocks, cylinders, cones, and boxes would encourage creativity while stimulating concepts of geometry. Collections of small items such as rocks, beads, cubes, buttons, commercial counters, and other items can be used for counting, sorting, and categorizing. Containers of different sizes and measuring cups and spoons can illustrate the concepts of volume and capacity. The environment should also include number-related books; felt pieces or finger puppets to go with the books; and counting games using dice, spinners, and cards. It may also include computer software and other technology materials focused on math. Materials and props will support all children in learning mathematics and are particularly important in teaching preschool children who are English learners. The props and materials give concrete meaning to the words children hear in the context of doing mathematics.

  Children with physical disabilities may need assistance in exploring the environment and manipulating objects. Children with motor impairments may explore through observation or may need assistance from an adult or a peer in manipulating objects to do things such as count, sort, compare, order, measure, create patterns, or solve problems. A child might also use adaptive materials (e.g., large manipulatives that are easy to grasp). Alternately, a child might demonstrate knowledge in these areas without directly manipulating objects. For example, a child might direct a peer or teacher to place several objects in order from smallest to largest. Children with visual impairments might be offered materials for counting, sorting, or problem solving that are easily distinguishable by touch. Their engagement is also facilitated by the use of containers, trays, and so forth of materials that clearly define their workspace.

- **Integrate math-related materials into all interest areas in the classroom.**
  Math naturally takes place throughout the classroom and throughout the day. Children explore objects and learn about shapes and numbers as they go about their daily routine and play in different areas in the classroom. Number symbols, for example, naturally appear throughout the classroom,

from real-life objects such as a tape measure, a telephone, a calculator or a scale to puzzles, stickers, books, and cards with numbers. Some teachers may choose to have a math table or a math area in the classroom for math-related materials, games, books, and manipulatives. In addition, the teacher should integrate math-related materials and props into all activity areas in the classroom. The dramatic play area can include a scale, a calculator, a measuring tape, and other math-related tools. The art area can include shape and number stickers, magazine cutouts of numbers, and shapes for collage making. The same tool can be used in various places throughout the environment. Measuring cups and spoons, for example, can be used for cooking, but also in the science or discovery area, in the dramatic play area, and for playing with sand and water.

- **Provide real-life settings in the preschool environment.**
  Real-life settings to investigate, such as a grocery store, a restaurant, a woodshop, or a bakery, help children learn naturally about everyday mathematics. They present children with numerous opportunities for mathematical reasoning and problem solving. Such settings demonstrate for children mathematical concepts through props and concrete objects, familiarize children with numbers in their everyday use (e.g., price tags, labels, measurements) and with the function of various tools (e.g., a scale, a register, a measuring tape). A real-life setting such as a grocery store or bakery, for example, can engage children in sorting and classification of items, in measurement experiences (e.g., measuring the weight of produce), and in solving simple addition and subtraction problems. Children enjoy learning mathematics through the acting out of different roles in real-life settings.

- **Use materials and objects that are relevant and meaningful to the children in your group.**
  Mathematical concepts and skills such as counting, sorting, and measuring can be learned with different materials and in various contexts. It is valuable to introduce math in a context that is familiar and relevant to children's life experiences. Use materials, books, and real-life settings that reflect the culture, ways of life, and languages of the children in the group. When mathematical concepts are embedded in a context that is personally relevant to individual children, experiences are more pleasurable and meaningful.

- **Use children's books to explore mathematics with children.**
  Include books with mathematical content, and use children's literature to develop mathematical concepts. Children's books provide interesting and powerful ways to explore mathematics. Teachers can use books to introduce and illustrate different

mathematical concepts, to encourage the use of mathematical language, and to develop mathematical thinking. Some books, such as counting books and shape books, directly illustrate mathematical concepts. Other books, such as storybooks, provide context for mathematical reasoning (e.g., *The Very Hungry Caterpillar* or *Goldilocks and the Three Bears).* The following sections include suggestions about how teachers can use literature to present and discuss different mathematical concepts, including counting, addition and subtraction, patterns, shapes, comparison language, and spatial positions. Many stories can be acted out by including concrete objects and manipulatives. While reading aloud books with mathematical content, teachers can pose questions to children, ask them to predict what comes next based on an underlying principle or a repeated pattern in the story, or invite children to re-create stories in their own way. See the "Teacher Resources" on page 297 for a list of children's books with mathematical content and other related resources on the use of literacy in teaching mathematics. For ideas on adapting books for children with physical disabilities, please refer to the Literacy section on pages 106 and 107.

- **Be intentional and mindful in setting up and using the physical environment.**
A math-rich environment is very important, but it does not guarantee that children will engage in meaningful mathematical experiences. The teacher should be intentional when planning a math-rich environment and think about how different math-related objects in the classroom can be utilized to promote meaningful mathematical exploration and reasoning. Teachers should allow children the time to become involved with the materials, help children reflect on what they are doing, and extend their learning and discoveries through questioning and mental challenges. The next sections include more detailed information about how to set up a rich physical environment to promote number sense, classification, measurement, and geometry concepts for all children.

Summary of the Strands and Substrands

The California preschool learning foundations in mathematics identify a set of age-appropriate goals expected for children at around 48 and 60 months of age in five developmental strands.

- **The Number Sense strand** refers to concepts of numbers and their relationships. It includes the development of counting skills, the understanding of quantities, recognizing ordering relations (which has more, fewer, or less), part-whole relationships, and a basic understanding of "adding to" and "taking away" operations.
- **The Algebra and Functions (Classification and Patterning) strand** concerns the development of algebraic thinking and reasoning. Included in this strand is the ability to sort, group, and classify objects by some attribute and to recognize, extend, and create patterns.
- **The Measurement strand** involves comparing, ordering, and measuring things. Included in this strand is the child's ability to compare and order objects by length, height, weight, or capacity; to use comparison vocabulary; and to begin to measure.

- **The Geometry strand** concerns the study of shapes and spatial relationships. Included in this strand is the child's ability to identify, describe and construct different shapes, and to identify and label positions in space.
- **The Mathematical Reasoning strand** is a process in learning and developing mathematical knowledge in all areas of mathematics. Included in this strand is the child's ability to reason and apply mathematical knowledge and skills to solve problems in the everyday environment.

Please refer to the map of the mathematics foundations on page 296 for a visual explanation of the terminology used in the preschool learning foundations.

The following curriculum framework in mathematics provides teachers with strategies to promote preschool children's reasoning and understanding of key mathematical concepts in each of the five strands. The strategies provide teachers with tools for building children's understanding of mathematics over time, through a mathematically rich environment, through interactions and conversations with children during play and everyday routines, and through intentionally planned mathematical experiences. Examples of "Mathematical Reasoning in Action" are interwoven throughout the chapters, illustrating children's reasoning about different mathematical concepts, whether in natural situations or while engaged in planned mathematical activities.